Impacts and emergency response to the 12 June 2006 South Island snowstorm: tabulated results of a survey of responding organisations in the Canterbury region

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GNS Science Report 2008/40
April 2009

BIBLIOGRAPHIC REFERENCE

Wilson, T. M.; Johnston, D. M.; Paton, D.; Houghton, R. 2009. Impacts and emergency response to the 12 June 2006 South Island snowstorm: tabulated results of a survey of responding organisations in the Canterbury Region, *GNS Science Report* 2008/40 p.66

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ISSN 1177-2425
ISBN 978-0-478-19653-5

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ABSTRACT

The June 2006 Canterbury snowstorm caused widespread impacts to the Canterbury region, resulting in a major regional emergency response. The result of a large atmospheric depression moving across the South Island from the Tasman Sea, snowfall was experienced across much of the South Island on the evening of 11-12 June 2006. By the late morning of 12 June much of southern and central Canterbury was covered by a significant thickness of snow. Urban and rural communities across the region suffered widespread disruption of lifeline services, in some cases for extended periods. The greatest impacts were experienced in Ashburton, Mackenzie, Timaru and Waimate districts.

There was particularly widespread and severe damage to electrical distribution networks due to the heavy weight of the dense, wet snowfall. Telecommunication services failed as batteries in exchanges were unable to sustain services once mains power was lost. Disruption of transportation networks by the snow for periods of a few hours to several days hindered the emergency response. The rural sector in particular was heavily impacted by loss of electrical power services and telecommunications for an extended period of time (up to 3 weeks in some areas). Livestock losses were minimal on most farms, although the loss of condition resulted in a considerable reduction in many farms' productivity. Widespread damage occurred to fences, trees and some buildings.

To investigate the impacts of the June 2006 snowstorm and assess how responding agencies managed the event, a survey was sent to 92 individuals or organisations involved in the emergency response to the snowstorm approximately 12 months after the event. The survey aimed to record damage experienced as a result of the June snowstorm event, impacts on urban and rural communities, the effectiveness of organisations' response plans for the snowstorm event, warning and reaction to the snowstorm event, and what lessons can be learnt for dealing with future snowstorms. This report presents the results of the survey in table format, with limited interpretation and analysis in the final section.

KEYWORDS

Snowstorm, snow, physical impacts, social impacts, emergency response, Canterbury

1.0 INTRODUCTION

On the evening of 11-12 June 2006 a large depression caused snow to begin to fall across the Canterbury region. By the late morning of 12 June much of southern and central Canterbury was covered by a significant thickness of snow. The snowfall, along with high winds, caused disruption across the region in urban and rural communities. In particular there was widespread disruption of power, telecommunications and road networks. In some cases disruption continued for extended periods of up to 3 weeks. The greatest impacts were experienced in Ashburton, Mackenzie, Timaru and Waimate districts.

Electrical distribution networks suffered particularly widespread and severe damage due to the relatively heavy weight of the snow. Telecommunication services failed as batteries in exchanges were unable to sustain services once mains power was lost. Disruption of transportation networks by the snow for periods of a few hours to several days hindered the emergency response. Rural communities in central and south Canterbury were heavily impacted by loss of electrical power services and telecommunications for an extended period of time (up to 3 weeks). Livestock losses were minimal on most farms, although the loss of condition resulted in a considerable reduction in farm productivity. Widespread damage occurred to fences, trees and some buildings.

1.1 12 June snow storm event

1.1.1 Previous snow storms

A number of large snow storms have been experienced in Canterbury previously, with similar significant events occurring in 1945, 1967, 1973, 1992, 1996, and 2002. Typically snowfall thicknesses are greatest in the high country and foothills areas of western Canterbury, with lower plains and coastal areas in the east receiving considerably less snowfall. It is common for snow fall thicknesses to be highly variable across the Canterbury region during these events, which includes the 2006 event.

In general, large snowstorms affecting the South Island of New Zealand are the result of rapidly deepening depressions from the Tasman Sea south-eastward across New Zealand (Hendricks, 2006). When the pressure falls rapidly within the centre of these depressions it can lead to very large precipitation rates and consequently heavy rain or snowfalls, especially if the storm stalls over an area for more than 24 hours (Hendrikx, 2006).

1.1.2 12 June 2006 meteorological conditions

On 11 June 2006 a mid-Tasman sea depression (low pressure system) rapidly deepened. The depression tracked from the Tasman Sea south-eastward across New Zealand with a strong north-westerly air stream ahead and a very cold southerly flow behind. Rapidly deepening depressions may be accompanied by high precipitation rates and consequently heavy rain or snow. The centre of the depression passed over the northern South Island on 12 June (Hendrikx, 2007). Heavy snow began falling in Canterbury on the night of 11-12 June and continued until the morning of 12 June.

It was reported by Hendrikx (2007) that strong vorticity advection at upper levels in the atmosphere (above 500 hPa or about 5 km) was the key factor behind the rapid deepening of the storm's centre on 10-11 June. This led to intense vertical motion in the northwest flow ahead of the front associated with the depression (commonly referred to as a moisture conveyor belt). This resulted in heavy precipitation rates over the surface low and very cold air undercutting the front from the southwest, which caused the precipitation to fall to the ground as snow rather than rain (Hendrikx, 2007).

The topography of the Southern Alps influenced the distribution and extent of the snow. As the depression moved across the Southern Alps, the original centres of the system weakened on the western side, whilst new centres reformed off the east coast of Canterbury on 12 June. To the south of where these centres reformed was where the most intense storm activity and great snow depths were experienced, resulting in southern Canterbury being significantly effected. This complexity increased the difficulty in forecasting the extent and location of the snow storm (Hendrikx, 2007).

The storm was classified as a 'vorticity advection type' storm by Hendrix (2007) after Neale and Thompson (1977). The storms that occurred in 1945 and 1996 which both resulted in thick snow falls to Canterbury can also be classified as such storms (Hendrikx, 2007).

1.1.3 Distribution of snow

An approximate map of maximum observed snow depths for the Canterbury region was created by Hendrikx (2007) from interpolation of 53 data points (Figure 1). Whilst no account of topography has been made within the map it is sufficient to provide an understanding of the snow depth across Canterbury.

The following has been taken from Hendrikx (2006) as analysis of the distribution of snowfall thicknesses across Canterbury:

> *The area from about Temuka to Rakaia had up to 30 cm down to sea level with increasing amounts towards the northwest and into the lower foothills. Deeper pockets of snow were experienced around Methven and Lyndhurst Station. Further south, most coastal areas (e.g. Timaru, Oamaru) had 20-30 cm of snow, while areas such as Glenavy and Studholme had less snow with maximums of 5-10 cm recorded.*
>
> *Inland areas around Farlie, Kimbell and Burkes Pass had much deeper snow than the Canterbury Plains, with depths commonly exceeding 70 cm. Further west into the McKenzie Basin, snow depths decreased with 40-50 cm being more common across most parts.*
>
> *North of Rakaia, the snow depth decreased northwards and eastwards with 20-30 cm on the plains near Lincoln, decreasing to 5-6 cm on Brighton Beach in Christchurch and 10-15 cm in Amberly. Deeper pockets of snow were experienced west of*

Darfield with 75 cm recorded at Homebush Station. Towards the foothills snow depth also increased with 50 cm in Springfield and 80 cm at Ryton Station.

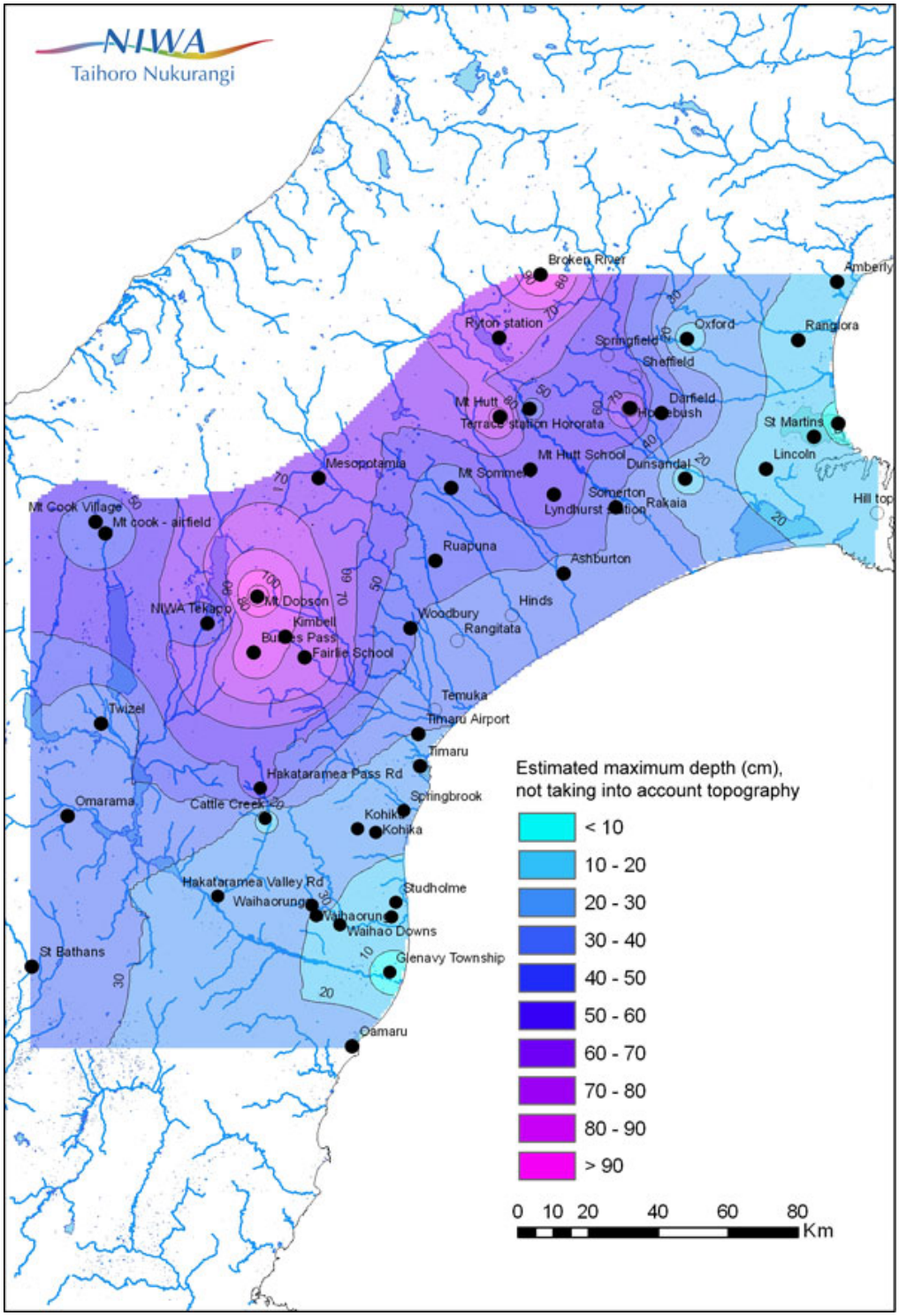

Figure 1: Maximum observed snow depths (cm) from the June 12, 2006 snow storm across the Canterbury Region. Taken from Hendrikx (2006). Note the snow depth interpolation surface only considers the data points and does not attempt to account for the effects of topography.

The intensity and severity of the snow storm surprised urban and rural communities. Snowfall had only been forecast to reach down to 500 m above sea-level, but heavy falls occurred at sea level across large areas (Figure 1). Whilst inland regions typically receive some snowfall every year, snowfalls at sea level in Canterbury are rare. The timing of the snowstorm was also earlier in winter than many previous snow events.

The heavy weight of the snow and longevity of the snow impeded the initial response and eventual recovery. The month of June in 2006 was the coldest in over 50 years, and successive frosts froze the snow so that it persisted in some areas for up to seven weeks. As the storm occurred early in the winter, there was significant concern of another snow storm impacting the region and greatly compounding effects.

1.1 Method

In April 2007, a questionnaire survey was sent to 91 individuals or organisations involved in responding to the snow storm approximately 12 months following the event. The aim of the survey was to assess the impact of the event, document the response and recovery, and record lessons for future snowstorm emergency response. Organisations surveyed were selected following a review of Canterbury Civil Defence and Emergency Management (CDEM) Group Situation Reports, media reports, and interviews with Jon Mitchell and John Fisher of Canterbury CDEM Group.

The survey was designed to estimate:

a) Damage and loss from the snowstorm to organisations;
b) Preparations organisations had made for snowstorm hazards; and
c) Performance of organisations during the snowstorm event and the interactions with other organisations during this crisis.

All surveys were apparently successfully delivered. A total of 27 responses were recorded (Tables 1 & 2). This gave a survey response rate of 29%. However, as different managers or department heads within one organisation (such as councils) were involved in different aspects of the snowstorm response, each manager was sent a survey in an attempt to document the complexity of the response. With the exception of one organisation which returned two completed surveys, in all other cases only one survey which detailed the entire organisation's response was returned from each organisation receiving multiple surveys. Therefore 26 responses were recorded from a possible 62 organisations giving a response rate of 42%. When only lifelines organisations and emergency services (including councils and defence force) are considered, a response rate of 58% is recorded (15 responses from 26 organisations).

When interpreting these results it should be acknowledged this is a very small sample size.

Mail questionnaires were our preferred survey method because of their cost-effective nature, and their ability to allow respondents to make considered responses to complex and interlinked questions. However, we acknowledge the problem of demographic bias in the sample associated with this method. As a consequence, the conclusions and recommendations suggested here should be viewed with this in mind (Leonard *et al.*, 2004).

Table 1: Responding agencies

Responding Agency	Count
Councils[1] (Ashburton, Christchurch City, Selwyn, Timaru, Waimakariri)	5
Electricity Suppliers/Lines Companies	5
Transit	1
Telecommunications Providers	1
Stock and Station Agents	5
Ministry of Education	1
Emergency Services (Police)	1
Defence Force	1
Work and Income (Ashburton and Timaru)	2
Federated Farmers Regional Managers	2
Rural Service Providers	1
RESPONDING ORGANISATIONS	25

1: Surveys were sent to the Emergency Management Officer, Welfare Manager and Infrastructure Manager.

Table 2: Area responding organisation is based

Area Organisation Based	Count
Christchurch	2
Waimakariri District	1
Selwyn District	1
Ashburton District	5
Mid Canterbury	2
Timaru District	2
Twizel, Mackenzie and Waitaki Basins	1
Central Canterbury	2
Canterbury Region	3
South Canterbury	3
Rangiora	1
North Canterbury	1
Burnham	1
TOTAL	25

1.2 Format of the report

This report follows the general format of the questionnaire, which can be found in Appendix 1. The first section presents information about the experience of responding organisations to natural hazard events and on the plans responding agencies have in place to deal with snow-storm (or other adverse) events. It also reports on the inter-organisation co-operation within response plans, and what occurred during the snow-storm event. The report then covers when organisations were warned, what their reactions and decisions were, implementation of their response plans, and how warning and hazard information was distributed to the community. The report continues to cover what response actions organisations took to deal with the effects of the snowstorm, a catalogue of reported effects of the snowstorm, and the total costs of the snowstorm to each organisation. The final

section details what long term effects and future impacts the snow storm will have on the organisation and on the wider community.

This report is a collation of the responses from the survey with relevant comments and early conclusions in places. It should not be considered a comprehensive impact assessment of responding organisations following the snowstorm event.

Comments included within the report are given as by respondents from returned surveys.

2.0 NATURAL HAZARD EXPERIENCE AND RESPONSE PLANS

2.1 Natural hazard management experience

Respondents generally had a good level of expertise in dealing with natural hazard events (Table 3). Nearly half (46%) had dealt with an event more than four times. Only 3 of the responding organisations had never dealt with a snowstorm event (Question 2).

Table 3: Organisation experience in natural hazard management

Times involved in a natural hazard event	Count	%
Never	3	11.5%
Once	4	15.4%
Two – four times	7	26.9%
More than four	12	46.1%
TOTAL	26	100%

Respondents generally perceived themselves to have considerable (50%) or a moderate amount (38%) of personal experience in dealing with snowstorm events (Table 4). The majority (69%) believed their agency had considerable experience in dealing with snowstorm events, with only 8% believing their agency to have very little experience (Question 3).

Table 4: Perception of personal and organisation's experience in natural hazard management

Perception of personal experience	Count	%	Perception of agency's experience	Count	%
Considerable	13	50.0%	Considerable	18	69.2%
Moderate amount	10	38.5%	Moderate amount	6	23.1%
Very little	3	11.5%	Very little	2	7.7%
TOTAL	26	100%	TOTAL	26	100%

2.2 Organisation's response plan

Nearly all responding agencies had a response plan for dealing with a snow-storm related disaster (85%, Table 5). Only 15% of agencies had a specific snowstorm plan (Table 6). Most (69%) adapted another plan. Fifteen percent didn't have a response plan.

Table 5: Presence of a response plan for organisation

Did organisation have a response plan	Count	%
Yes	22	84.6%
No	4	15.4%
TOTAL	26	100%

Table 6: Origin of Response Plan

Plan was based on	Count
Specific snow storm plans	4
Adapting of plans	18
TOTAL	22

Table 7 shows that most plans catered for technical or infrastructural problems, staff competencies/well-being, community issues and social issues. Political and economic issues were dealt with less well.

Table 7: Aspects the organisation's response plan included

Plan catered for	Yes		No		No Response		Total	
	Count	%	Count	%	Count	%	Total	%
Technical/infrastructure problems	15	57.7%	1	3.8%	10	38.5%	26	100%
Staff competencies/well-being	16	61.5%	1	3.8%	9	34.6%	26	100%
Community issues	17	65.4%	1	3.8%	8	30.8%	26	100%
Economic issues	7	26.9%	6	23.1%	13	50.0%	26	100%
Political issues	10	38.5%	4	15.4%	12	46.1%	26	100%
Social issues	15	57.7%	2	7.7%	9	34.6%	26	100%

2.2.1 Inter-agency planning

Table 8: Presence of inter-agency management planning

Did plan include inter-agency management planning	Count	%
Yes	17	77.3%
No	0	0%
No response	5	22.7%
TOTAL (*of responders with plan*)	22	100%

Table 9: Organisations or agencies included in response plans

Agency Groups	Agency included within response plan	Count	Totals
Emergency Services	Emergency Services	1	
	Police	7	
	Fire	4	
	Ambulance (includes St. Johns)	3	
	Rescue Team NZRT12	1	
	Hospitals	2	18
Councils	Christchurch City Council	1	
	Ashburton District Council	2	
	Canterbury Regional Council	3	
	Waitaki District Council	1	
	Mackenzie District Council	2	
	Waimate District Council	2	
	Timaru District Council	1	
	Local District Council	4	16
Infrastructure Providers	Infrastructure provider	1	
	Orion	1	
	Telecom	3	
	Roading contractors	2	
	Water Services contractors	1	
	Electricity Ashburton	2	
	Sewerage	1	
	Water Supplies	1	
	Electricity Distribution Companies and Generators	2	14

Community Welfare Groups	Community welfare groups	2	
	Neighbourhood Support	1	
	Red Cross	2	
	Salvation Army	1	
	Rural Women NZ	2	
	Victim Support	1	
	Country Women's Institute	1	10
Civil Defence	Civil Defence	8	
	Ashburton District Council CD controller	1	9
Government Social Welfare Agencies	Child Youth and Family	2	
	Inland Revenue	1	
	Heartlands Fairlie	1	
	Heartlands Twizel	1	
	Heartlands Waimate	1	
	Welfare agencies	2	8
Rural Support Agencies	MAF	3	
	Federated Farmers	4	7
Contractors involved in emergency response and recovery	Helicopter operators	2	
	Transport operators	1	
	Truck Contractors	1	
	Earthmoving Contractors	1	
	4WD Club	1	6
Local Radio	Local Radio	2	2
Animal Welfare Agencies	SPCA	1	
	Veterinary Services	1	2
County Agencies	County agencies	1	
	Resource Centre Temuka	1	2
Key Communication Sites	Key communication sites	1	1
Stock and Station Agents	Key Branch Offices	1	1

There appears to be little linkage to the Canterbury CDEM group (Canterbury Regional Council, n=3; Civil Defence, n=8), which is surprising considering they are meant to be the strategic controlling body.

The media was only included in two response plans (Local Radio, n=2).

Approximately 30% (7) of respondents felt that no unexpected inter-agency issues emerged as a result of the response (Table 10).

Table 10: Unexpected inter-agency issues that emerged as a result of the response

Unexpected inter-agency issues that emerged as a result of the response	**Count**	**%**
Yes	7	26.9%
No	18	69.2%
No response	1	3.8%
TOTAL	26	100%

Problems with inter-agency interaction that were noted by respondents included (verbatim):

- Severe problems with Rural Telephone Exchanges with flat batteries, due to power loss and pathetic Telecom response (issues still not addressed) despite promises;
- Police - had to be encouraged to take part in the response & only then for one day. They had no problems so didn't realise/understand they could play a role in gathering information (door knocking);
- Power Company - Excellent liaison & cooperation however lacked ability to provide restoration times;
- Cell site (back up power limitations), key telecommunication sites (back up power);
- Invitation to attend Canterbury Co-ordinating Executive Group teleconferences during event;
- MAF never had a plan that enabled them to have an early recognition of the level of the effect of the snow on the rural community. Our Company offered our widespread network which wasn't utilised;
- An expectation from the media the Ministry of Education closed schools in these circumstances when it is a School Board of Trustees decision; and
- Local council did not make contact regarding Welfare issues.

2.2.2 Response plan activation

Table 11: Point response plan implemented

At what point was the response plan implemented?	Count	%
No response plan	6	23.1%
On receiving warning	10	38.5%
On receiving impact assessment	8	30.8%
No response	2	7.7%
TOTAL	26	100%

Table 12: Time it took for response plan to become operational

How long did it take for the plan to become operational	Count	%
Immediately	1	3.8%
1.5 hours	1	3.8%
2 hours	1	3.8%
4 hours – due to access difficulties	1	3.8%
0.5 days	3	11.5%
Less than 1 day	5	19.2%
1 day	5	19.2%
2 days	1	3.8%
No response	8	30.8%
TOTAL	26	100%

Table 13: Sense of time it took for response plan to become operational

Sense	Count	%
Longer than expected	1	3.8%
As expected	16	61.5%
Quicker than expected	1	3.8%
No response	8	30.8%
TOTAL	26	100%

2.2.3 Constraints to plan implementation

Table 14: Constraints to plan implementation

What constraints to plan implementation did you encounter	Count
No constraints	10
Time for mobilisation	5
Time to obtain resources	2
Resources not available	2
Inadequate coordination	2
Not wanting to raise unnecessary alarm	1
Inadequate communication with community members	1
Inadequate communication with other agencies	1

Issues identified by respondents:

- Dependant on duration of the storm;
- Advised after midnight of first snow, total extent of snow noted as reported;
- Telecommunication failure;
- None of the above applied as we just worked out what needed to be done & went and did it. No communication so communicated verbally by travelling 20km to get people up & worked from there; and
- No telephone, no power.

3.0 WARNING, REACTION AND INFORMATION AVAILABILITY

3.1 Was warning given?

Where clear warning is given before extreme climatic events, detailed and refined preparations can often be made by agencies likely to be involved in any response and recovery efforts. However, in the case of the June 2006 Snowstorm there was limited warning of an event that was very difficult to forecast from metrological agencies. This reflected the degree of warning respondents felt they received, with less than half (46%) of the respondents believing they were not given any warning of the potential impacts of the snowstorm event (Table 15). Twenty six percent of respondents said they had one day's warning and the remaining 26% said they had more than one days warning (Table 15).

Table 15: Warning received by organisation

What warning were you given about the potential impacts of the snow storm event?	Count	%
Not given any warning	12	46.1%
One day	7	26.9%
More than one day	7	26.9%
TOTAL	26	100%

3.2 Source of warning information

Table 16: Agency which supplied warning information

Agencies which supplied warning information	Count
Meteorological Service	14
From within my organisation	6
Television	4
Radio	4
District Council	3
Ministry of Civil Defence & Emergency Management	2
Regional Council	2
Local Civil Defence	2
Newspaper	2

3.3 How was warning information received?

Table 17: How warning information was received

Did this information reach you in your official capacity?	Count	%
Official	9	34.6%
Other	6	23.1%
No response	11	42.3%
TOTAL	26	100%

Comments from respondents included:

- As the manager of a company servicing the rural community from our staff network my organisation is constantly monitoring weather patterns & changes. Snow storm as well publicised in the public arena (newspaper, etc);
- Phone calls to ex-army officer at CDEMG;
- Radio weather warning;
- Request for assistance from District Council while snow still falling (ipm 12/06/07);
- Through own observations & communication with management & staff members;
- Voluntary registration;
- We monitor weather impacts, 2-4 hour indication; and
- Weather forecast from radio/TV.

3.4 What actions resulted on receipt of warning information?

What action(s) resulted from the receipt of this information?:

- Situation was monitored-don't impact on the City or Banks Peninsula as it do for Mid & South Canterbury;
- Monitored situation, from low key activation of EOC. Links established with ES;
- No practical action could be taken other than keeping people/agencies aware;
- Had already spoken with Relief Co-ordinator (9am) and put contingency plan in place. Checked availability of volunteers;
- As the snow predicted was not of a significant amount no special precautions of actions were taken. Snow is a normal occurrence for us and the 15-20cm predicted was not seen as a problem. Forecast at 20:37hrs Sunday the 11th of June;
- Notified our contractors;
- Ensured contractors and sub contractors were prepared and all necessary arrangements were in place;
- Issue warning to staff of potential storm;
- Organisational awareness within the Telecom Network Operations Centre and Field Force;
- Mobilised staff in affected areas to contact and call on farmers to gauge the level of need;
- Not much;
- Preparing for extra needs required by customers before storm hit - more stock on shelves etc;
- Activated Army response plan; and
- The Mid Canterbury Emergency Relief Trust activated the Emergency Relief Headquarters at Federated Farmers Buildings.

Responses from Question 13*: What was your first reaction?*:

- Keep key personal within my organisation advised of the situation;
- Monitor by Patrol and Reconnaissance;
- Activate EOC, gain an appreciation of size and impact of the events;
- Was aware at 6am that depth of snow 25cm and still falling heavily would be major event. Contacted high country farmers (phone tree) as often most affected. Checked snow levels across District (phone tree). Liaised with Council operations manager re state of roads-graders had started at 6am on priority roads (policy) but poor progress till snow ceased 2pm;
- No problem, we may have some road access issues in the morning;
- To cancel all planned work;
- Mobilise repair teams as fault appeared on the transmission system. Ensured back up teams were prepared as storm intensified;
- Prepare;
- Heightened awareness;
- The rural community had a problem based on our staff feedback;
- Get plenty of wood in by the house;
- Wait to see extent of problem;

- Possible disaster;
- I went to work to assist with emergency response co-ordination;
- Activated "OP AWHINA", prepared utilities & prepared for potential deployment; and
- That this was not a very bad snow. Day two displayed the full impact of the damage caused.

3.5 Warning and impact information availability

Table 18: Perception of threat to the community following initial warning

How serious a threat to the community did you think the storm event might be – after initial warning	Count	%
Very serious	3	11.5%
Somewhat serious	6	23.1%
Not serious	5	19.2%
Not sure	1	3.8%
No response	11	42.3%
TOTAL	26	100%

Table 19: Contact with others following warning

On being informed, did you contact other people or agencies	Count	%
Yes	8	30.8%
No	8	30.8%
No response	10	38.5%
TOTAL	26	100%

Respondents were asked to list, to whom, when and what they information they shared following being informed of the snow storm event. Many of the people contacted were in the rural sector (possibly related to responding population).

To whom?

- Liaison with the Canterbury CDEM Group & Emergency Co-ordination Centre (EOC);
- EOC Managers, Police, Fed Farmers;
- All (rural) relief trust members available;
- Other transmission contractors from other areas;
- Contractors;
- Re mobilised on staff based on previous experience - concentrated canvas of the farming community to identify their needs and with 1 day of snow fall;
- Civil Defence, Council; and
- District Council, Federated Farmers, Helicopter reconnaissance.

When?

- During the storm on 12 June;
- Once snow started;
- 9am - 6pm;
- As the storm increased and fault appeared on the transmission system;
- Straight away;
- At first emergency co-ordination meeting; and
- Day one.

What did you tell them?

- Kept the Canterbury CDEM Group EOC informed;
- Just heads up on situation and swap contact details;
- Likelihoods of full alert when snow ceased. That operations centre would open 8am Tuesday if accessible (achieved), Current known state of services. Listen to radio;
- Generally put contractors on alert in the North Island and asked them to prepare to be dispatched to the South Island to back up the current crews in the field;
- Be on alert, gather resources;
- Identified their needs and the extent of the stock problem; and
- Arranged to fly over the high county to check where stock were.

Table 20: Problems making a decision on available information

Did you have problems making a decision based on information available to you	Count	%
Yes	0	0%
No	12	46.1%
No response	14	53.8%
TOTAL	26	100%

Ten respondents (38%) believed they had the right amount of information to make decisions on their appropriate actions to take in response to the snow-storm (Table 21). Only one respondent (4%) believed they didn't have enough information and none believed they had too much information. Note there was a high level of non-response to this question (58%).

Table 21: Information load and availability

Did you receive	Count	%
Too much information	0	0
The right amount of information	10	38.5%
Too little information	1	3.8%
No response	15	57.7%
TOTAL	26	100%

When respondents sought information about the snowstorm, 31% found it readily, whilst 12% found it difficult to obtain (Table 22). Several sources were used by 31% of respondents when obtaining further information, whilst 12% required only one source (Table 23). The sources listed by respondents included the Canterbury CDEM EOC, Meteorological services, media, and information sourced from within their own network (Question 19).

Table 22: Information availability

If you sought information, was it	Count	%
Readily available	8	30.8%
Difficult to obtain	3	11.5%
No response	15	57.7%
TOTAL	26	100%

Table 23: Information source availability

Was the information you required obtainable from	Count	%
One source	3	11.5%
Several sources	8	30.8%
No response	15	57.7%
TOTAL	26	100%

Respondents were asked to describe the source(s) of information they deemed necessary for their role (summarised in Table 24).

Table 24: Key information sources for responding organisations during the snowstorm

Agency	Count
Canterbury CDEM Group Emergency Operations Centre	3
MetService	4
Blue Skies	1
Neighbouring Councils	2
Local Farmers	2
Roading Contractors	1
Electricity Company	1
Telecom	1
General News Media	1
Information sourced from own network/contractors in field	1

3.6 Sources of information that need to be developed

Respondents were asked what type of information/data they would like to see in hazard warning that would have assisted their decision making during the snow storm event (this has been aggregated in Table 25).

Table 25: Aggregated responses of information that would assist in decision making during snowstorm

General Issue	Info. that would have assisted decision-making	Count	Total
Increased analysis/communication of snowstorm attributes	More detailed weather map - greater analysis of data	1	
	Depth of snowfall	1	
	Extent of snowfall (increased resolution in warning)	2	
	Likely duration of snowfall	1	
	When will the snow likely stop	1	
	How "wet" or heavy is the snow	2	
	Wind chill factors	1	9
Increased Accuracy of weather forecast	MetService warning – recognising this is very hard!	4	
	Rapid changes in weather systems	1	5
Impact of snowstorm	Likely impacts (i.e. road and community impacts)	3	
	Danger of fallen electrical wires	1	
	Rapid delivery of detailed snow depths post event	1	
	Actual impact information based on a farm call network	1	6
Community Education Measures on dos and don'ts in the event of a snowstorm		1	1
None		2	2

Respondents were asked to list which sources of information they felt should be developed to promote better preparedness should such an eventuality occur in the future. Responses were aggregated in Table 26.

Table 26: Aggregated responses of information sources respondents feel should be developed to promote better preparedness should such an event occur in the future

Groups	Issue	Count	Totals
Coordination of response	Better utilisation of existing local networks by Government agencies	1	
	Improved distribution of warning, hazard and mitigation information at local level	1	
	Improved co-ordination of national level response	1	
	More regular welfare agency group meetings to share information	1	
	Development of relief trust - to coordinate rural response effort	1	
	Improved communication and links with community	1	
	Improved dissemination of information from CDEM and District Council to responding organisations and wider community	1	
	More rapid response by Central Government for relief funds	1	8
Warning/ forecasting	Estimation of impact intensity and magnitude	1	
	Effective warning system	1	
	More accurate forecasting	3	
	Earlier public warning of potential snowstorm events	2	7
Readiness	Database of spare parts and specialised equipment	1	
	Increased proactiveness by national bodies to increase awareness	2	
	Universal snow hazard/risk communication in schools	1	
	Greater assistance for business continuity planning	1	5
Lifeline Services	Implementation of promised upgrades to rural telephone exchanges	1	
	Upgrade to rural power lines structure	1	
	Protocol to work with power companies to influence restoration schedule	1	
	Improved resilience of telecommunications networks	1	4
Social Welfare	Improved support of family unit	1	1

Possible lack of coordination is highlighted by a series of comments, which identify areas to improve coordination at a national level down to specific elements at local levels, during the response phase. Highlights here include receiving a faster response from central Government in regard to what relief funds are will likely be allocated. There is also desire at a district or local level for better distribution of information from Civil Defence to response stakeholders and the wider community. Access to information during an emergency response is essential to making effective decisions.

Improved forecasting of snowstorm events is requested, although this is unlikely to change rapidly as such events are very difficult to forecast accurately. The desire for information on the likely intensity and magnitude of impact is however something that meteorological services may be able to provide, even if this is only given during the event.

Increased reduction and readiness measures are also noted, such as improved hazard awareness education strategies and access to business continuity planning. A database of spare parts and specialised equipment for emergency response purposes has particular merit for all hazards and should be considered by local CDEM groups.

3.7 Warning the community

Table 27: Presence of mechanisms in place to warn the community

Did you have mechanisms in place to warn the community?	Count	%
No mechanisms	10	38.5%
Mechanisms in place	15	57.7%
No response	1	3.8%
TOTAL	26	100%

If the organisation had measures in place, they were asked to list them (aggregated in Table 28).

Table 28: Aggregation of mechanisms used by organisations to warn the community

Group	Mechanism	Count	Total
Media	Media release	3	
	Radio	9	
	Television	1	
	Newspaper	2	15
Telecommunication	Telephone Trees	7	
	Call Centre	3	10
Internet	General	2	
	Own website	1	3
Miscellaneous	Schools	1	
	CDEM Lines & radio backup	2	
	Political	1	

Table 29: Effectiveness of mechanisms to communicate warning information to community

If these mechanisms were used, how effective were they in achieving their purpose?	Count	%
Very effective	9	34.6%
Somewhat effective	5	19.2%
Not very effective	1	3.8%
Not sure	0	0%
No response	11	42.3%
TOTAL	26	100%

4.0 IMPACTS OF THE SNOWSTORM AND RESPONDER MITIGATION ACTIONS

4.1 Actions taken to deal with effects of the snowstorm

Table 30: Actions taken to deal with the effects of the snowstorm

Did your agency take action to deal with the effects of the snowstorm	Count	%
Yes	25	96.2%
No	1	3.8%
TOTAL	26	100%

Respondents were asked if their agency took actions to deal with the effects of the snowstorm. Responses are listed below:

- Provided manpower & vehicle to District Councils affected by the storm;
- EOC Activated, linkages established with contractors and ES, priority roads cleared, priority access sites cleared, our rescue team deployed to Ashburton and Waimate to assist gather data on people welfare;
- Coordination & participation of response;
- Road clearing. Restoration of rural reticulated water supplies, welfare provisions for those in need;
- 2pm onward helicopter reconnaissance. 5pm Mon 3 teams despatched to deal with shed collapse on 2000+ pigs. Poles, tarpanlins, loaders for temporary shelter. Worked into night. Tues got roads cleared (not on list) by ADC & transported bulldozer to high county before snow froze. At pig farm all day. Assembled snow rakers. Wed teams followed bulldozer and dropped by helicopter for snow raking by 5pm 5500 sheep recovered!! (48 hours). Still team at pig farm. Thurs-Sun further 10,000 sheep, cattle & deer to safety in Mid & South Canty;
- Clearing snow from solar panels, grading roads, restoring local power supplies to power-stations, transporting diesel for backup generators, using alternative comms;
- Response – 6 days. Recovery – 2 months. Mutual aid to help others respond;
- Restore electricity supply;
- Mobilised repair crew & best we could bearing in mind people's safety. Kept informed of transmission events as they occurred on the system. Set repair priorities. Requested back up crews to be ready to mobilise if requested;
- Sent staff to affected areas, helicopter patrol, liaised with Civil Defence, liaised with Councils, Radio reporting;
- 1. Immediate request to maintenance contractor to initiate response to emergency snow situation. 2. Managed and organised contractors priorities and areas to concentrate resources. 3. Advice to client and his road condition reporting system. 4. Managed total area situation by liaising with contractors and advising all affected parties. 5. Inspected area prepared restoration estimate and report for Transit to approve;
- Mobilised, Impact assessments, Prioritised restoration of network and cellular sites, restored sites, including providing generators, liaised with Civil Defence;
- Within 3 days we have a comprehensive view of the level of the disaster, after utilising all our resources i.e. staff and contact with the rural community. Thereafter organised snow raking parties from within and outside the affected areas were utilised. Community food & basic requirements were made available. Thereafter a feed/hay etc schedule was documented;
- Contacted all clients to see if they requested any assistance;
- Assist our clients where needed;
- Providing support for staff & families. Accessing appropriate stock for customers needs. Assessing how safe it was to continue to work i.e. snow load, safe to drive on roads etc;
- Responded to all emergency calls as required. Assisted Civil Defence;
- Delivered radios & kit to outlying areas. Provided unimogs. Provided help support;
- Managed individuals welfare need. Managed clean up work force;

- Met with numerous organisations including local authorities, federated farmers, MAF, and resource centres. Four teams of workers were established to assist with the on farm cleanup in the Timaru, Waimate and Mackenzie area;
- The immediate action was to get the Emergency Relief Trust Co-ordinator up in a helicopter to assess the severity of the storm. Then as requests for help came in, mobilise the resources available. Experienced manpower to snow rake sheep out of deep snow to lower altitudes where they could be fed;
- Co-ordinating people in other areas and our own to help where it was needed basically starting somewhere & when the job was done move on to the next place of need; and
- Anama Branch of Rural Women NZ Members & once they were able to travel they visited homes with food etc.

4.2 Positive Outcomes of Actions

Table 31: Perception the organisation's actions led to positive outcomes

Do you think that your actions led to any positive outcomes?	Count	%
Yes	24	92.6%
No	1	3.8%
No response	1	3.8%
TOTAL	26	100%

Respondents were asked to describe the outcomes:

- Assisted two District Councils to make contact with members of the public whom contact had not been made;
- Closer working relationship, people we met were please to see us, positive feedback once situation across district explained, good exercise to use responder team in real event;
- Access for the community. Restoration of essential water supplies for consumers. Welfare provided to those in need;
- Only 1-2% of 2000 pigs lost despite all sheds collapsing. In total 15,000 plus stock recovered by snow raking teams. Minimal losses. Placed generators on dairy farms to milk 1000 cows. Placed generators on dairy farms to feed 4000 pigs? Poultry. Sourced hay & silage for emergency feed. Got power supply to major feed industry as priority connection etc,etc,etc;
- Identified areas for improvement which have been implemented, showed the willingness of staff to band together, fully tested our response plans & showed the value of out scenario training;
- Map of damage updated on internet so progress could be monitored;
- Reduced transmission outage times. Ensured wires that were down were safe to the public;
- We supplied digital photographs of extent of damage & accessibility to councils & CD, also provided regular GIS screen dumps of affected customers to CD;
- Priority restoration of cellular sites, development of co-ordinated impact assessment, close interrelation between TNZL and Civil Defence, close interrelation between TNZL and Power Companies;
- We satisfied a considerable amount of residents in the affected area with food, staff/labour, feed, personal support;
- Reassured clients that company network was available for their assistance;
- Build relationships with clients;
- Generally people (customers) were happy that we were able to help them when they required help. Very tolerant of late payments, problems on farm, lack of power etc;
- Great community support. Neighbourhood support relevants unavailable;
- The local population could see that real action was being carried out!;
- Unemployed people received employment and the department was seen in a positive light;
- Over 130 property owners were assisted to clean-up properties;
- Saved approx 30,000 sheep, 2000 pigs assisted to provide generators for milking cows;

- A better understanding of the requirements of the local community & by those people having a local community of Interest to work in. All this has to work from the bottom up not from the top down; and
- If a family home was in need of help it was reported back to their chairperson who acted on it.

4.3 Problems organisations encountered in performing their roles

Table 32: Organisations that experienced problems performing role during response

Did you experience any problems in performing your role?	Count	%
Yes	12	46.1%
No	14	53.8%
TOTAL	26	100%

Respondents were asked to list problems, which are presented below:

- Gathering intelligence on the situation when lines of communication were out;
- Very poor service from Telecom. Lack of Army personnel availability (poor communication channel). Late response from Government-not interested in South Island. No helicopter nets for feed. No transport subsidy or GST exemption. Felt is was a PR exercise;
- Staff shortages (transport & other impacts affecting personnel),lack of impact information, communication impacts, lack of resources vs. wide spread impact e.g. generators;
- Cell phone communications;
- Access to sites for repairs, ability to control work resource to maintain safety, insufficient skilled resource;
- Always challenges when you are directing operations for the field. Main issue is ensuring repair crews are not subject to extreme temperature/condition for long period. They must be supported and able to communicate as they go about their business;
- Widespread loss of electrical power, significant access (road) disruption causing difficulty getting to sites, significant potential staff Health and Safety issues, ongoing continuing nature of storm;
- I live in the country, no phone lines, no electricity so couldn't re-charge cell-phone, not possible to drive on roads;
- Some staff didn't come to work a first day. They got the message;
- One of the major problems was the way some of the other agencies reacted in regard to OSH in particular you can't be in intimidated by this and we all have to work accordingly; and
- I was unable to leave my home for 4 wks but was able to contact some members to begin their role of help.

Table 33: Why organisation didn’t have problems with their response to the snowstorm

If no, was this because	Count	% of sample
The response plan was effective	8	30.8%
No response was necessary	5	19.2%
Other	1	3.8%
TOTAL	14	14

The comments made by these organisations are made below:

- This plan is practiced and exercised annually, EOC staff trained and competent, prior contacts established and reinforced;
- Regular training;
- Senior personnel familiar with required response for this emergency situation (similar to floods or storm damage);
- Our industry and staff have experienced snow storm in the past and respond accordingly;

- General common sense prevailed, a good team working together to help others;
- There was very strong support provided by management to support all of the logistical tasks needed to carry out the cleanup work; and
- The Mid Canterbury Emergency Relief Trust is set up to assist farmers initial response in a climatic release event.

Respondents were asked to list problems that adversely influenced their organisation's effectiveness in responding to the snow storm event (Table 34). They were asked to estimate how serious a threat each was to response effectiveness.

Table 34: Problems that adversely influenced organisation's effectiveness in responding to the snowstorm event

	Posed a Problem		**If Yes**		
Problem	**Yes**	**No**	**Unimportant**	**Important**	**Very Important**
Lack of appropriately trained personnel	6	16	1	5	2
Lack of equipment	9	13	1	7	2
Lack of facilities (e.g. accommodation)	4	17	0	4	0
Inadequate communication with other agencies	6	16	1	3	2
Inadequate communication with the community	10	13	0	5	4
Inadequate coordination of response	5	17	0	2	3
Lack of clear responsibility for coordination	5	18	0	2	3
Media problems	4	18	1	4	0
Management issues	2	20	1	1	1
Public cooperation	2	21	1	2	0

Respondents were asked to provide additional information on issue(s) relating to response effectiveness.

- Inadequate accommodation for volunteers carrying out welfare response was an issue. Additional generators for use in the communities would have been desirable. Due to phones not working, it was difficult to gauge community welfare needs, and to inform the public that we were asking for anyone with welfare needs to come forward;
- Civil Defence radios were excellent for snow raking, satellite phones would be great, but costly. Local media were excellent. National TV/Radio less so in that they put up helicopter to find pig shed to interview owners. This was not appropriate and unsuccessful. Seemed to lose interest when they were no real bad news stories;
- We no longer have heavy machinery available so had to rely on good relationships with local contractors;
- Difficult to accommodate work crews at short notice. Community generally understands 'lights out' during such events but are generally intolerant long periods. General public are generally very good in supporting crews in the field!;
- Additional generators purchased during the event;
- Available resources and networks were not utilised quickly enough;
- The Mid Canterbury Emergency Relief has been established by Federated Farmers and Ashburton District Council to provide specialist help to farmers in an adverse climatic emergency. The 12 June snow emergency was able to be managed by drawing on previously identified resources of people and equipment within the community; and
- One of the problems with the organisation I'm involved in was a lack of understanding of the expectations to our organisation. Possibly a briefing of what could be expected of us in this role in the future.

Table 35: Perception of response plan effectiveness

If your response plan was implemented, how effective was it?	Count	%
Very effective	12	54.5%
Somewhat effective	7	26.9%
Not very effective	0	0%
Not sure	0	0%
No response	3	13.6%
TOTAL *	22	100%

* 22 responding organisations reported having a response plan (Table 5)

4.4 Effects of the snowstorm

Respondents were asked to describe the major effects of the snowstorm in their area of operations:

- None-the City/Banks Peninsula received only a light covering of snow which didn't last long
- Good coverage but no real problems in Waimakariri;
- Increase public awareness of need for disaster preparedness. Opportunity to practice emergency management system & lines;
- Road closures, loss of power, loss of telecommunications, loss of water, stock welfare, financial hardship for those unable to get to work;
- Loss of access. Loss of power, water & sewerage. Loss of feed. Loss of feed quality. Damage to farm buildings and fences. Loss of trees. Loss of power of electric fences. Stock health issues. A whole new generation of Ashburtonians realized what "mother nature" can provide;
- Transport disruption, water disruption, power disruption, telephone disruption, financial pressure through impacts on employers, building collapses, closure of schools for 1 week, staff shortages in essential industries, social impacts through prolonged exposure to the event;
- The lack of a local power authority person to quickly restore power to the Twizel township. Had to wait 3 days for someone from Fairlie to do some switching, we could have had power within a few hours. The boundary problems with road clearing & different contractors for different stretches of road;
- Loss of power for some;
- Loss of electricity supply;
- Loss of transmissions to key substations for multiple periods throughout the storm;
- Loss of power for 2 days. Damage to lines & poles. Safety of staff as hours worked increased;
- Closure of all State Highways including SH1. SH1 was opened same day with other highways either same day or later the last to be opened was SH79. Damage occurred to marker posts and RRPM's and one area of first coat seal;
- Loss of service to +/- 10 000 customers, massive aerial line damage, isolation of some Telecom exchanges, cabinets and remote radio sites;
- Livestock losses;
- Stock losses, stock to be rescued/feed, houses without phones - not able to find out if they needed help, houses without power;
- Damage to power lines;
- Heavy snow in hill country-stock losses, loss of electricity, vehicle movement difficult;
- Staff could not travel out to schools. Schools were closed;
- Lack of power, food shortage, loss of income, seasonal work was not available;
- The major effects were the impact on farmers to carry out their daily tasks. There was also a considerable social effect on the family members of affected farmers and community members;
- Substantial damage to buildings, winter feed crops, electricity lines, houses;
- Helping one another as the need was required; and
- No power for some homes up to 14 days. Women living alone with children unable to get out to buy food.

Table 36: Perception of intensity of effects from the snowstorm

Were the effects of the snow storm:	Count	%
Much greater than expected	8	30.8%
Greater than expected	11	42.3%
As expected	7	26.9%
Less than expected	0	0%
Much less than expected	0	0%
TOTAL	26	100%

Respondents who perceived the effects of the snowstorm to be different (in this case all greater) from their expectations were asked to describe why:

- Time to restore power & telecoms;
- Due to the heavy wet nature of the snow, the damage caused was greater, especially to the electricity network. The snow stayed around longer than would normally have been expected compounding stock & access issues & welfare issues;
- Deepest snow depths in over 80 years east of the railway. Not many over 80's involved. Impossible to simulate;
- I didn't expect the entire population to be affected by an emergency event to the degree this one did. I struggle to anticipate another scenario that would have such wide spread & universal effect. Especially: transport 100% out, power x% out, phone x% out;
- More snow then predicted which resulted in failures to our local 33kv network;
- A. 60% of damage was caused by trees. B. Wet snow had a significant impact compared with dry snow;
- The size the snow dump was unexpected as was the ongoing nature of the snowstorm. Prolonged power outages. Prolonged disruption to access routes;
- Isolation-and remedial services took a considerable time to satisfy the community-mainly because of the scale of the disaster;
- Under estimated the effects of the depth of snow-feeding stocks. Under estimated the length of time for phone & power to be restored;
- Power outage longer than expected;
- The inability to co-ordinate acting because managers were unable to get to the office/work place;
- The impact on our clients due to power & phone outages. The damage caused by the snow to rural properties in South Canterbury;
- This was a particularly wet snow which for the amount that fell was particularly destructive on electricity poles and lines and on buildings;
- Not different from my expectations, because I have experienced it before but I do consider we handled it better; and
- Young families coping in these conditions found it some what difficult-never experienced this before.

Respondents who perceived the effects of the snowstorm to be similar (in this case all greater) to their expectations were asked to describe why:

- Very little impact that cause little disruption;
- Previous events and experience, snow is a regular event although not as severe;
- We have experienced snow events in the past;
- Previous snows of varying depths since Trust was formed were a sound basis for expectation. Service continuity of members and multi agency background helped. E.g. Self farmer/CD Manager/Fed Farmers 40yrs/Council 20yrs,Co-ordinator MAF, High Country, Radio, ATS manager others with similar backgrounds and great local knowledge;
- If the snow had been as predicted this would have been based or our experience from 2002,1995 etc;

- Previous snow storm of 1992 and experience with the Southland storm of ???;
- Previous history of damage & restoration from past storms;
- Effects were similar to those experienced in heavy snow falls observed over 30+ years;
- Practical experience of servicing the rural community;
- Personal experience of farming in Southland;
- Years of being involved in emergency events;
- Having lived most of my life in the high country this appeared as an often seen occurrence. However it was earlier than the norm;
- Nobody can accurately predict the effect of a snow storm; and
- Previous snow storms. Feeding levels are better now and this provides a better survival rate for animals.

4.5 Total cost of the snowstorm

Respondents were asked to report the total cost (estimated or otherwise) to their organisation in terms of the response to the snow storm. These are provided in Table 37.

These reported costs can be compared to an estimated $50 million cost to insurance companies for the South Island from private claims. An estimated $35 million of these costs came from the Canterbury region (FMG, 2006).

Table 37: Total cost (estimated or otherwise) to organisations in terms of the response to the snowstorm

Category	Responses	Total *(only includes $ listed)*
Management & coordination	▪ Clearance of snow from roads not separately captured-minor cost ▪ Costs only ▪ $48,000 all together with management/coordination, social support ▪ $350,000 ▪ $80,000.00 ▪ Business as usual + $5000 ▪ $279,000 ▪ No cost ▪ $25,356 ▪ Unknown ▪ Unknown ▪ Doesn't apply because we are a voluntary organisation ▪ MAF Policy invoice $26,367.61	$813,723.61
Clean up/Snow clearing	▪ Water supply power restoration $42,000 ▪ All volunteers ▪ $5,000 ▪ $500.00 ▪ $100,000	$147,500
Social Support	▪ Rescue response - volunteer using Council vehicles ▪ Welfare $40,000 ▪ Apart from TFG about 500-600 voluntary hours plus meetings ▪ Utilisation of staff and communiation ▪ $2,500 ▪ For members travel	$42,500

Restoring damaged buildings	▪ 12,000 ▪ *Private $millions* ▪ $250.00 ▪ $10,000	$22,250
Restoring damaged electricity lines	▪ $650,000 ▪ $1.3 million ▪ $600,000.00 ▪ $80,000	$2,630,000
Total electricity company costs	▪ $160,000 total ▪ $695,000 ▪ $1.3 million ▪ Total $1,000,000 ▪ $90,000	$3,345,000
Restoring damaged roading and management	▪ $70,000 ▪ $2 million ▪ $15,000.00 ▪ Isitts culvert seal coat $20,000 ▪ Road clearance & grit $560,000	$2,665,000
Restoring damaged telecommunications	▪ $3 million	$3,000,000
Miscellaneous	▪ Waimakariri got off lightly with no real expenses and major disruption ▪ $160,000 total ▪ Farm paddocks e.g. fence lines and wood lots ▪ Emergency generators, roading, water supplies, waster water/sewerage all together were $600,000 ▪ Total cost on council $2.3m	$3,060,000
Total	*(Adjusted for duplications)*	**$12,380,973.61**

Table 38: Summary of Impacts, Actions and Outcomes (as reported by respondents)

SECTOR	IMPACTS	ACTIONS	OUTCOMES
Electrical Power Networks	Loss of power (regional) The lack of a local power authority person to quickly restore power to the Twizel township Loss of transmissions to key substations for multiple periods throughout the storm Damage to lines & poles. Safety of staff as hours worked increased No power for some homes up to 14-20 days (Mid-South Canterbury)	Priority access sites cleared Clearing snow from solar panels, grading roads, restoring local power supplies to power-stations, transporting diesel for backup generators, using alternative communications used Mobilised lines repair crews throughout Canterbury as possible, with consideration of worker's safety. Kept informed of transmission events as they occurred on the system. Set repair priorities. Requested back up crews to be ready to mobilise if requested Sent staff to affected areas, helicopter patrol, liaised with Civil Defence, liaised with Councils, Radio reporting Response-6 days. Recovery-2 months. Mutual aid to help others respond	Identified areas for improvement which have been implemented, showed the willingness of staff to band together, fully tested our response plans & showed the value of our scenario training Map of damage updated on internet so progress could be monitored Reduced transmission outage times. Ensured wires that were down were safe to the public Electricity suppliers supplied digital photographs of extent of damage & accessibility to councils & CD, also provided regular GIS screen dumps of affected customers to CD.
Telecommunication Networks	Loss of telecommunications Loss of service to +/- 10 000 customers, massive aerial line damage, isolation of some Telecom exchanges, cabinets and remote radio sites	Priority access sites cleared Mobilised, Impact assessments, Prioritised restoration of network and cellular sites, restored sites, including providing generators, liaised with Civil Defence	Priority restoration of cellular sites, development of co-ordinated impact assessment, close interrelation between TNZL and Civil Defence, close interrelation between TNZL and Power Companies
Transportation Networks	Road closures The boundary problems with road clearing & different contractors for different stretches of road Closure of all State Highways including SH1. SH1 was opened same day with other highways either same day or later the last to be opened was SH79. Damage occurred to marker posts and RRPM's and one area of first coat seal	Priority roads cleared 1. Immediate request to maintenance contractor to initiate response to emergency snow situation. 2. Managed and organised contractors priorities and areas to concentrate resources. 3. Advice to client (Transit) and the road condition reporting system. 4. Managed total area situation by liaising with contractors and advising all affected parties. 5. Inspected area prepared restoration estimate and report for Transit to approve	Access for the community
Water Distribution and Sewage Networks	Loss of water Water & sewerage	Restoration of rural reticulated water supplies	Restoration of essential water supplies for consumers
Social Welfare Agencies	Social impacts through prolonged exposure to the event Lack of power, food shortage, loss of income, seasonal work was not available Women living alone with children unable to get out to buy food	Waimakariri rescue team deployed to Ashburton and Waimate to assist gather data on people welfare Welfare provisions for those in need Managed individuals welfare need. Managed clean up work force Once members were able to travel they visited homes with food, etc	Over 130 property owners were assisted to clean-up properties (Timaru) Unemployed people received employment and the department was seen in a positive light (Ashburton and Timaru) If a family home was in need of help it was reported back to their chairperson who acted on it (Mid Canterbury Rural Women)

Education	Closure of schools for up to 1 week Staff could not travel out to schools		
General CDEM/District Council		Provided manpower & vehicle to District Councils affected by the storm EOC's activated Linkages established with contractors and Emergency Services Coordination & participation of response	Assisted two District Councils to make contact with members of the public whom contact had not been made. Closer working relationship, positive feedback once situation across DISTRICT explained, good exercise to use responder team in real event
Agricultural Emergency Managers and Rural Support Trusts	Stock welfare Loss of feed Loss of feed quality Damage/collapse to farm buildings and fences. Loss of trees. Loss of power of electric fences Stock to be rescued/feed Houses without phones or power - not able to find out if they needed help Stock losses, stock to be rescued/feed, houses without phones - not able to find out if they needed help, houses without power Heavy snow in hill country-stock losses Vehicle movement difficult Substantial damage to buildings, winter feed crops, electricity lines, houses The major effects were the impact on farmers to carry out their daily tasks. There was also a considerable social effect on the family members of affected farmers and community members	2pm onward Helicopter reconnaissance. 5pm Mon 3 teams despatched to deal with shed collapse on 2000+ pigs. Poles, tarpanlins, loaders for temporary shelter. Worked into night. Tues got roads cleared (not on list) by ADC & transported bulldozer to high county before snow froze. Assembled snow rakers. Wed teams followed bulldozer and dropped by Helicopter for know raking by 5pm 5500 sheep recovered!! (48 hours). Still team at pig farm. Thurs-Sun further 10000 sheep, cattle & deer to safety in Mid & South Canterbury Within 3 days a comprehensive view of the level of the disaster was obtained within Mid Canterbury by Mid Canterbury Emergency Relief Trust, after utilising all resources i.e. staff and contact with the rural community. Thereafter organised snow raking parties from within and outside the affected areas were utilised. Community food & basic requirements were made available. Thereafter a feed/hay etc schedule was documented In Mid Canterbury there was extensive meetings with numerous organisations including local authorities federated farmers MAF and resource centres. Four teams of workers were established to assist with the on farm cleanup in the Timaru, Waimate and MacKenzie area The immediate action was to get the Mid Canterbury Emergency Relief Trust Co-ordinator up in a helicopter to assess the severity of the storm. Then as requests for help came in to mobilise the resources available. Experienced manpower to snow rake sheep out of deep snow to lower altitudes where they could be fed	Mid Canterbury Emergency Relief Trust saved approx 30,000 sheep, 2000 pigs (1-2% losses), assisted to provide generators for milking cows >15,000 livestock were recovered by snow raking teams in South Canterbury, with minimal losses. Placed generators on farms to assist with milking (1000 cows) and feeding/heating 4000 poultry and pigs (Mid Canterbury) Sourced hay & silage for emergency feed. Established power supply to major feed industry as priority connection

Stock and Station Agent Business Response	Financial hardship for those unable to get to work Financial pressure through impacts on employers	Providing support for staff & families. Sourcing appropriate stock for customers needs. Assessing how safe it was to continue to work i.e. snow load, safe to drive on roads etc Contacted all clients to see if they requested any assistance Assist our clients where needed	Met considerable number of residents in the affected area with food, staff/labour, livestock feed, personal support (North, Mid and South Canterbury) Reassured clients that company network was available for their assistance. Build relationships with clients Firms were tolerant of late payments.
Emergency Services	Some staff weren't able to come in on the first day.	Responded to all emergency calls as required. Assisted Civil Defence	Great community support. Neighbourhood support unavailable
Defence Forces		Delivered radios & kit to outlying areas. Provided Unimogs.	The local population could see that real action was being carried out.

5.0 LESSONS FOR THE FUTURE

5.1 Learning from the experience

Nearly all (85%) respondents believed they learnt from their experiences of dealing with the snowstorm (Table 39).

Table 39: Learning from the Experience

Did you learn anything from your experience in dealing with the snow storm	Count	%
Yes	22	84.6%
No	2	7.7%
No response	2	7.7%
TOTAL	26	100%

If the respondent answered yes, they were asked to describe what they had learnt:

- Need for early warning, need to respond rescue teams earlier rather then later, practice and exercise helps for smooth transition, importance of establishing relationship with other agencies before the emergency;
- A more formal SOP has now been produced. Special procedures for dealing with issues such as grading of roads & restoration of water supplies. The standard welfare response in an emergency focuses on providing welfare at welfare centres. During the 2006 snow, welfare was provided to people in their own homes. It was not necessary to open any welfare centres;
- Every event is different e.g. snow depths in certain areas, organisation must be "flexible". Don't rely on Armed forces! You can never have too many volunteers. Railways no longer have stocks of tarpaulins;
- To be explicit when activating volunteer response org. To better manage/coordinate public info so radio stations reflect the messages to a wider area then just the District with the loudest voice. Expect & manage unsolicited donations of aid. To manage the public expectation with explicit messages. Better coordination of information gathering and analysis. Coordination of recovery efforts, particularly in rural areas;
- Contracts for road clearing should be based on locally not price. Our diesel tanks should be topped up more regularly. All our training had paid off. The staff were very dedicated;
- Keep reporting simple and focussed. Allow operational people to perform their normal role. Inform the public and others especially with respect to restoration times (don't over promise and under deliver);
- Always learning. Each event brings with it new challenges. Wider spread power outages than experienced before. Terrain was different. Types of faults were different;
- Changing weather patterns may see a review of engineering design in areas that were historically non alpine regions;
- Response from one maintenance contractor exceeded expectations. Other contractor managed situation well as expected;
- Telecom carried out a full review and made information available to participants;
- Get out a respond quickly, but putting together a schedule of the level of the problem, community needs, and action plan to satisfy;
- Get staff to areas quickly, stock the products required;
- Establish a response plan for ourselves. More communication with other agencies;
- The need to co-ordinate communication. That key managers/staff may not be available because of break down in communication services to read a co-ordinated response;
- Made some good contacts;
- Notify local council when department staffing changes occur, especially management as they sit on the welfare agency group;
- The need for strong interagency cooperation. Gathering and actions on relevant information to make sound decision;

- The need to have a group willing to assist must be updated annually. Preparation and having people who have agreed to assist are the first requirements communication is vital!; and
- Animal Welfare Issues need to be addressed purely by extraction to a safe point so they can be fed accordingly. Meaning that in the event of more snow you had things under control.

Respondents were asked to describe any positive or negative effects resulting from this experience (Table 40).

Table 40: Positive and negative effects resulting from this experience

Positive	Negative
▪ As above. ▪ Road clearing hierarchy emergency plan worked well. Donation of money which allowed purchase of portable repeater & sat phone. ▪ Real event better than an exercise! For training. Rural people very resilient. Local knowledge is paramount. ▪ People are better prepared. Council gained much positive feedback. The community response neighbour to neighbour was outstanding. ▪ CDEM and local authority communications. ▪ Staff supportive. ▪ Public support in the field on the day. ▪ Training for junior staff. Team co-operation. ▪ Revised our action response plan. ▪ Increased profile in the local civil defence. ▪ Great community support. ▪ The experience alone stands people in better understanding for another time.	▪ Don't rely on Telecom. Don't wait for Govt in the urgent phase. ▪ Require better customer information data, require better message handling systems, communication systems. ▪ Telecommunication breakdown. ▪ Don't rely on Civil Defence in the country. ▪ Need a more resilient, electricity & telecommunication infrastructure.

5.2 Long term impacts and changes

Many of the respondents expected there would be some long term effects from the snow storm (Table 41).

Table 41: Reported long term effects of Snowstorm

	Count	%
Political	5	19.2%
Social	6	23.1%
Community	5	19.2%
Ongoing maintenance lines	1	3.8%
Public perception	1	3.8%

Respondents were asked to describe these effects:

- Many people have subsequently purchased generators. Some dairy farmers now have backup generators. Many people are now better prepared with their telecommunication facilities (car charges, backup to domestic cordless phones). CD survival kits have been established/upgraded. Heightened awareness within the community to being prepared for such events;
- Social/economic - impacts to farmers & other business will take some years to recover;
- Other lines companies took up to three weeks to restore all power. This had a negative impact with some customers;
- Lines stressed during snow storm are likely to produce unforseen failures;
- Changes to our designs;
- Perception of ability of the Telecom network to deliver service during a similar event;
- Loss of livestock on farm improvements. Farm profitability;
- The amount of money spent on feeding stock and repairing damage limited spending on other farm requirements for a season;
- Client today said it has taken a year to get his farm back in order;
- Political: Both national & regional & local governments were slow to respond & to acknowledge damage done and needs that were not recognised for some time. Power back on etc. Economic: Changes in farming practices due to damage, no insurance;
- Make people aware of their vulnerability at need to plan better for exceptional circumstances;
- There maybe a greater political awareness of any future snow storms. Plus it appears that weather prediction is focused on the worst case;
- In the political, economic, social and community experience of the 12-06-06 snow storm, groups and individuals have made changes to prepare themselves more adequately for future climatic achieved events; and
- Farmers definitely would have a financial burden after the snow storm. Some farmers & families would experience some social issues after the event. Farmers lock of financial stability for a time in this event would have created some community issues through the lack expenditure on inputs into their farm for at least one year.

5.3 Future resilience

Most respondents (96%) believed their organisations were well prepared to deal with any future snowstorm event, on the basis of the 2006 snow storm (Table 42).

Table 42: Organisation preparation for future snowstorm events

How well is your agency prepared to deal with any future snowstorms events? (On the basis of the 2006 snow storm)	**Count**	**%**
Very well prepared	15	57.7%
Well prepared	10	38.5%
Not well prepared	1	3.8%
TOTAL	26	100%

Respondents were asked to describe how they based their assessment:

- The arrangements in place to deal with an emergency and arrangements in place with contractors/supplies. Infrastructure providers have learnt much from the 2006 storm & implementing or discussing changes;
- We have our plans and regular exercises, CD community sector well organised;
- From lesson learned from the 2006 event & implement measures to address these;
- I believed we did a reasonable job in the circumstance. Helen Clark, Jim Anderton, Rick Barker and many others agreed as well as farmers assisted. NB: We are not complacent about future events;
- Experience & lessons learnt;

- Because we handled the 2006 event very well & we have since made improvements to our systems & procedures for the future;
- A. Construction standards reviewed by international consultants. B. Some operational improvements made. C. Centralised control and restoration planning ensures optimal decisions. D. Major outage communications plan developed. E. Mature contractor management and systems in place. F. Systems spares holdings regularly reviewed and seismically restrained. G. Robust radio communications in place. H. Mutual aid agreement in place and working with other South Island line companies;
- While some improvements have been undertaken many of the larger issues require significant planning and time. The has to be balanced with ongoing capital development of the system. Immediate customer requirements;
- Experience gained from previous event. Good preparedness by contractors. Broader knowledge of types of fault we might experience;
- Experience, we own our contractors - loyalty, good recovery plans;
- Client (Transit New Zealand) satisfaction positive response from other affected parties and agencies;
- Improvements made subsequent to the event as a result of impact report;
- Experience. Current updated disaster plan. Support from Senior Management of our Company;
- Better prepared with stocking levels of critical products;
- That we are implementing a response plan;
- Nationally we have been involved in a number of natural disasters e.g. North Island flooding;
- Every experience is a learning exercise, the group have met already and have up graded operational policy in the light of the 12-06-06 experience; and
- Just on how these agencies reacted during the event.

Most respondents (85%) believed it was either very likely (13) or somewhat likely (9) that a snow storm of this magnitude will occur in the future (Table 43). Only 2 respondents (8%) believed it was not likely.

Table 43: Perceived likelihood of a similar magnitude snowstorm in the future

How likely do you think it is that a snow storm of this magnitude will occur in the future?	Count	%
Very likely	13	50.0%
Somewhat likely	9	34.6%
Not likely	2	7.7%
Not sure	0	0%
No response	2	7.7%
TOTAL	26	100%

Respondents were asked to comment or list any changes they would make to increase resilience to snow storms in the future to their:

Organisation:

- Radio communications established in Lee's Valley since storm, (Isolated community) with portable power supply;
- Ongoing staff training. Regular review & updating of plans. Maintenance of liaisons with other key agencies;
- Fine tuning. More secure communications;
- Increase staff training to improve Emergency Operation Centre effectiveness;
- Increased distribution of satellite phones to key staff. Regular top up of back up diesel supplies. Increased 33kv pole maintenance. Agreements & understandings with local roading contractors;
- Currently reviewing systems and system tools to better manage the event;
- Better message taking and recording. Improve accessibility to some cities;

- Ensure emergency preparedness plans are current and appropriate. Ensure sub contract arrangements are maintained. Review 'readiness' of support teams from the NI and how they may be deployed in the SI environment;
- Opus consultant Nil-but ensure new staff are were familiar with procedures for emergency events (flooding, wind, snow, ice etc);
- 1. We published customer readiness information. 2. Revised our crisis management plan/process. 3. Participated in two exercises with external agencies. 4. Revised our process for communicating with local government/civil defence;
- Have revised our Disaster Plan Strategy;
- Update phone lists;
- We will maintain and constantly develop our capacity to assist in future;
- There's no substitute for experience and this tends to bring a bit of wisdom with it; and

Managed infrastructure:

- No;
- Backup diesel powered generators are being installed at all rural reticulated water supplies, with the exception of one where that community was not prepared to meet the cost;
- In hands of other agencies. Telecom-more backup. Electricity Ashburton-more resilient infrastructure. A. District Council-check staff welfare;
- Increase effectiveness of business continuity plans;
- As above;
- A. Build to reviewed standards (current standards) B. Targeted improvement to existing lines. C. Continue to encourage tree owners to keep their trees clear of lines;
- More robust data systems and remote information and control;
- Communication improvements internally (control centres to field operations etc);
- Replacement of weak conductors with stronger types. Use of stronger poles;
- 1. Communicated information on our network to civil defence and Engineering Lifelines Groups. 2. All cabinets involved in the event have had battery replacements and 3. Installed external generator connection plugs on 26 rural cabinets. 4. Determined restoration procedures for plug equipped cabinets. 5. Involving farmers in emergency powering arrangements for cabinets; and
- Needs to be improved but has to be managed by local input but we need the tools of govt agencies to implement it.

Other aspects of your business:

- We are all volunteers who meet annually to reassess structure & upgrade worker lists and representation. Very close links with helicopter company vital for early reconnaissance. We are all practical, self motivated persons. Key personnel about 10;
- Increased training to volunteers will contribute to community response & effective information gathering. Continue to liaise & plan with other organisations;
- Great opportunity for Army to help out in community, also good for PR; and
- Members worked closely with the co-ordinator based at Ashburton Fed Farmers building. "Emergency Relief" - very helpful.

6.0 SUMMARY

6.1 Impacts of the 12 June 2006 snowstorm event

6.1.1 Summary of reported economic impacts

A total cost of $12,381,000 was reported by responding organisations (Table 37). Telecommunications costs were approximately $3.0 million and electrical companies reported costs of $3.345 million. Road damage and costs were estimated at $2.63 million by transport network managers. Management and coordination costs were reported at over $0.8 million across responding organisations. Note these figures should not be treated as absolute figures for the Canterbury region, as they only reflect responses from the organisations who responded to this survey.

These costs can be compared to an estimated $50 million cost to insurance companies for the South Island from private claims (Small & NZPA, 2006). An estimated $35 million of these costs came from the Canterbury region.

Central Government also committed $1.63 million (Anderton, 2006) in financial assistance.

6.1.2 Effects of the snowstorm

A summary of key effects of the snowstorm were (in no particular order):

- Loss of electrical power (generally the key impact noted by the sample);
- Road closures and transportation disruption;
- Loss of telecommunications;
- Loss of water and sewerage;
- Staff shortages in essential industries;
- Livestock welfare issues – loss of feed and feed quality;
- Damage to farm buildings, fences, trees and loss of power to electric fences;
- Financial hardship for those unable to get to work;
- Financial pressure through impacts on employers;
- Building collapses;
- Closure of schools for 1 week; and
- And social impacts through prolonged exposure to the event.

The heavy, wet nature of the snow and widespread impacts causing major disruption to infrastructure networks were recurring reasons as to why this event caused such significant effects across the region. The disruption of key services and isolation of many households for extended periods were acknowledged as particularly difficult.

6.2 Outcomes from the snowstorm event

6.2.1 Actions taken to deal with effects of the snowstorm

Nearly all (96%) respondents took action to deal with the effects of the snowstorm (Table 30). Most organisations (73%) believed the effects of the snowstorm were either much

greater than expected (8) or greater than expected (11, Table 36). Twenty seven percent believed the effects were as they expected. No respondent believed the effects were less than expected.

The emergency responses of each agency were typically related to their own particular areas of responsibility. Typically responding organisations stated their first actions were to mobilise repair/maintenance crews, assess impacts and establish linkages with other organisations to coordinate the response. Repairing and/or clearing disrupted networks was a top priority for infrastructure providers. Disrupted transportation networks, lack of cellular phone communications (thus having to use alternative communications), and widespread power outages were noted as significant problems in the response. The responses from the sample indicated there was an effective prioritisation of key sites (mainly telecommunication sites, such as cellular sites) for power restoration, although there was no indication from responses as to how long this prioritisation took.

Welfare agencies typically looked to assess where needs were greatest and attempted to then mobilise available resources. Many agencies noted the importance of liaising with other responders and Civil Defence coordinators.

Analysis of responses from the sample indicated total appreciation/awareness of the magnitude of impacts took approximately 3 days. Responders indicated the response phase took between 6-12 days, whilst the recovery took 2-4 months (this will likely have been significantly longer for farmers; Smith, 2007).

The 54% of organisations that did not have problems during the snowstorm event believed this was because their response plan was effective (31% of sample) or no response was necessary (19% of sample, Table 33). Respondents believed their staff's previous experience with snow and good planning were essential.

Over half (55%) percent of responding organisations believed their response plan was very effective (Table 35).

6.2.1 Positive outcomes

Most respondents (93 %) believed their actions led to positive outcomes (Table 31). The responding agencies reported the following positive outcomes of the snowstorm event (in no particular order):

- Many responding organisations reported it allowed them to identify areas for improvement and their staff and organisation gained excellent experience from the event;
- Many responding agencies believed the snowstorm was a way to build relations with their clients. Several responding organisations indicated they had a better understanding of the local community;
- In several instances responding organisations commented they didn't appreciate how their business's unique abilities or attributes could greatly assist others in providing emergency response;
- Many responding organisations were very impressed at their staff's performance and

noted the valuable experience they had gained;

- Several responding organisations noted that their emergency management training paid off;
- The response to rescue livestock in difficulty was generally very successful; and
- *"Telecom has upgraded its rural exchanges"* [Respondent].

Generally electrical lines companies were commended for a "*pretty good job in difficult conditions*". Whilst several responses indicated power companies could more regularly provide updates on likely restoration times, the GIS maps provided by several of the lines companies for distribution to responders and publication in the media were regarded as highly successful.

6.2.2 Negative outcomes

Nearly half (46%) of the respondents stated they had difficulties in performing their roles during the response to the snowstorm event (Table 32). The responding agencies reported the following negative outcomes of the snowstorm event (in no particular order):

- Intelligence gathering and/or impact assessment was generally poor, especially with telecommunications disrupted;
- Very poor performance of the telecommunications network;
- Widespread loss of electrical power;
- Several responding organisations believed the Defence Forces had been poorly utilised, with one commenting they believed it was due to a "*lack of knowledge about how they are utilised*";
- Some responding organisations noted there was a lack of resources to adequately deal with the wide-spread response to the event, particularly aid from central government, staff shortages due to blocked roads, and heavy machinery for clearing and maintaining roads;
- Infrastructure providers were wary of OSH/health and safety for repair crews. Other responding agencies, particularly rural service providers, were frustrated by perceived 'red-tape' holding up the repair of critical infrastructure; and
- One major infrastructure provider felt it was unclear what was expected of their organisation in the response.

The lack of appropriate equipment (generators and heavy road clearing equipment) and inadequate communication with the community (volunteers and was difficult to monitor welfare needs with communications down) were the two most common problems that adversely impacted an organisation's performance.

"One of the problems with the organisation I'm involved in was a lack of understanding of the expectations to our organisation. Possibly a briefing of what could be expected of us in this role in the future" [Respondent]

Some respondents noted a lack of communication or understanding between agencies on some occasions. One believed that agencies not impacted severely or struggling should have taken a more active role to assist other struggling organisations. An example was noted by a Civil Defence EMO who believed the Police could have taken a more active role (and had to be encouraged to do so) in collecting information, such as door knocking.

One key lifeline provider was "surprised" at the invitation to join teleconferences of the Canterbury CDEM group co-ordinating the response. This perhaps reflected a lack of affiliation felt by some lifeline organisations to be involved in strategic emergency management at the time of the snowstorm.

Many respondents were disappointed at the time it took for central Government to confirm that aid money was going to be available. One respondent noted:

"…don't sit back and wait for MCDEM to take the lead on their issues. Agencies need to take the appropriate steps and communicate with their fellow response agencies and work through issues that concern them to ensure the next response is even more effective."

Media management was a potential issue as some respondents felt the national media in particular was incorrectly analysing the response, particularly in respect to them.

6.2.3 Long term impacts and changes

Many respondents believed the community will be more aware of their vulnerabilities and motivated to increase their household resiliency as a result of the snowstorm. However, many also acknowledged that farmers and some businesses will take many months to years to fully recover and force adjustments to how they operate their businesses.

Infrastructure providers were concerned snow damage may cause unforeseen damage to their networks in the medium to long term future. Some noted they believed the community will have a better appreciation of what level of service they can expect in future similar events.

Nearly all respondents (96%) believed the experience in the June 2006 snowstorm had increased their ability to deal with future snowstorm events (Table 43). Many indicated they had improved (or reinforced the value of) their emergency response plans and staff training systems. Some had installed backup generators.

Most respondents (85%) believed it was either very likely (50%) or somewhat likely (35%) that a snow storm of this magnitude will occur in the future (Table 43). Only 2 respondents (8%) believed it was not likely.

6.3 Warning information

6.3.1 Receipt of warning information

A feature of the June 2006 snowstorm event appears to have been the perceived lack of warning by responding organisations. Several organisations reported the snow depth predicted to fall before the event was perceived to be manageable and common for the region. However, by the morning of 12 June many organisations appeared to recognise that this was a significant event. Some organisations reported they didn't realise the full magnitude of the event until the 13th June.

Only 54% of respondents believed they received warning of the potential impacts of the snowstorm (Table 15). However, only 12% of respondents believed the event was going to be a very serious snowstorm after this initial warning (Table 18). Twenty three percent and 19% respectively believed it would be somewhat serious or not serious. This indicates the available warning information did not accurately predict the impact the snow would have.

The greater than expected intensity and impact of the snowstorm is highlighted by responses within Table 36. Most respondents (73%) believed the effects of the snowstorm were either much greater than expected (31%) or greater than expected (42%). Twenty seven percent believed the effects were as they expected. No respondent believed the effects were less than expected.

Warning information was received from 9 different sources by the 26 respondents (Table 16). Over half of the sample (54%) said they had received warning information from the Meteorological Service[1]. Twenty three percent of respondents said they had received a warning from within their own organisation. Television (15%), radio (15%), and newspapers (8%) were used as sources of information for some respondents, highlighting the importance of the media as a provider of warning information.

Warning information reached response managers from each respondent organisation in their official capacity in 35% of cases. Some organisations believed that hazard warning information was freely available:

"…snow storm was well publicised in the public arena (newspaper etc.)" [Respondent]

"We received sufficient information from the available sources to allow us to reflect repairs to faulted equipment as they appeared. The nature of snow storms does not allow asset preparedness rather prepare repair crews, plant & equipment to respond as necessary." [Respondent]

Stock and station agents in particular noted their reliance on the news media for keeping them up to date. This was potentially as they were not part of the CDEM Group. Some of the responding organisations (3) mentioned their reliance on complaints and customer feedback for monitoring impacts.

6.3.2 Meteorological warning

Significant challenges are faced by meteorological organisations attempting to provide warnings for snowstorms. The complex meteorological conditions that occurred during the storm created difficulty in forecasting the extent and location of the snowstorm (Hendrix, 2007).

In the case of the June 2006 snowstorm, the snow was relatively wet and dense, thus was more damaging. This raised the issue of whether the depth of snow is the only hazard information required to be distributed in warning messages. In this instance the density of

[1] Note that more than one source of information was permitted

the snow was equally important for estimating or assessing likely damage to infrastructure networks (i.e. electrical power lines) and buildings.

Many respondents indicated a strong desire for “better forecasting”. Primarily organisations desired more accurate warning information which included estimates on the depth of snow, length of storm, and better snow-hazard information (e.g. weight of snow, wind chill factor, fallen wires).

6.3.3 Information sources that need development

Responses from the sample on what information/data people would like to see in hazard warning that would assist their decision making were aggregated into three key areas (Table 25): increased analysis and communication of snowstorm attributes (9); increased accuracy of weather forecast (5); and impacts of snowstorm (6). The first and second areas provide difficult challenges for weather forecasters to deliver. The third suggests that better impact assessment needs to occur during the event and the information better disseminated to appropriate areas.

Responses from the sample also indicated a possible lack of coordination is highlighted by a series of comments, which identify areas to improve coordination at a national level down to specific elements at local levels, during the response phase (Table 26). Highlights here include receiving a faster response from central Government in regard to what relief funds are likely to be allocated. There is also desire at a district or local level for better distribution of information from Civil Defence to response stakeholders and the wider community. Access to information during an emergency response is essential to making effective decisions.

6.4 Management of the snowstorm by responding agencies

Respondents generally had a good level of expertise in dealing with snow storm events (Table 3). Nearly half (46%) have dealt with an event more than four times. Only 3 of the responding organisations have never dealt with a snowstorm event.

6.4.1 Actions that resulted from receipt of warning information

There were generally two actions that an organisation would take on receipt of hazard information; activate response plans and monitor impacts as they occurred. The loss of telecommunications was a common problem for many responders.

Many infrastructure network managers ensured contractors and sub-contractors were prepared. Generally this was reactive, with teams sent to respond as faults appeared. However, it became a difficult exercise with health and safety (ice and cold) and accessibility issues (blocked roads) meaning many contractors and repair crews were unable to perform their functions. The significant damage and disruption across large areas of various infrastructure networks compounded access and communications problems.

6.4.2 Contact with other responders and information sharing

On being informed of the warning information, 31% of respondents said they contacted other people and/or agencies (Table 19). The examples listed were mainly those directly involved in the response effort, such as the Canterbury CDEM EOC members, Police, Federated Farmers. Initially this was to establish lines of communication, impact assessment (i.e. state of services) and begin gathering resources (physical and human) for response. Responses all occurred within 24 hours of the first snow falling.

Shared information appeared to be mostly related to impacts and time till network restoration. The latter become an essential communication exercise for power companies to both the public and to other response agencies. One transmission company immediately began contacting other transmission companies outside of the impact area as the storm began to increase and faults starting occurring on the transmission system. Contractors were put on alert in the North Island and asked to prepare to be dispatched to the South Island to back up the current crews in the field.

No organisation believed it had problems making decisions on the information available (Table 20). However one respondent said that all decisions were initially made on their own information sources as no external sources of information were available. Of the respondents, 38% believed they received the right amount of information, whilst one respondent (4%) believed they didn't have enough information (58% did not respond to that question).

Over a quarter (27%, Table 10) of respondents believed there were unexpected inter-agency issues that emerged as a result of the response. Responses were related to either poor performance of telecommunications infrastructure, perceived poor performance of some agencies during the response (mostly related to poor impact assessment), or specific technical issues.

6.4.3 Response plans

Nearly all responding agencies had a response plan for dealing with a snow-storm related disaster (85%, Table 5). Only 15% of agencies had a specific snowstorm plan (Table 6). Most (69%) adapted another plan. Fifteen percent didn't have a response plan.

Most plans (77%) included inter-agency management planning (Table 8). Emergency services (18), territorial authorities (16, although this may include civil defence), infrastructure providers (14) and community welfare groups (10) were most represented in responses (Table 9), however there were a large range of different agencies included. There was a limited link to the media, despite the media being acknowledged as an effective method to communicate warning and hazard information (Table 9).

There appeared to be limited or no inclusion of the Canterbury CDEM Group EOC or ECC within many response plans, particularly by 'lifeline' providers (Table 9).

Response plans were initiated on receipt of snowstorm warning information by 38% of respondents, whilst 31% of respondents implemented their response plan on receiving impact assessment information (Table 11).

Of agencies with a response plan, 66% reported it taking less than 1 day for their response plans to become operational (46% of total respondents); with 38% (27% of total respondents) reporting it took less than half a day for their plan to become operational (Table 12). Five respondents reported it took 1 day, and one respondent reported it took 2 days for their response plan to become operational. Most respondents (89% of agencies with response plan) thought this time was as expected (Table 13); with only one reporting the activation time took longer than expected and one other reporting it was faster than expected.

Thirty eight percent of respondents believed there were no constraints to implementing their response plan (Table 14). Time taken to mobilise was the most reported constraint (5) on implementation of an organisation's snowstorm response plan, which is possibly indicative of lines of communication being impacted by the snow storm (telecommunications and roading networks disrupted). Three respondents specifically reported the loss of telecommunications as a constraint. Time taken to obtain resources, availability of resources and inadequate co-ordination were reported as constraints by several organisations.

6.4.4 Performance of responding organisations in warning the community

Over half (58%) of the respondents reported they had mechanisms in place to warn the community (Table 27). Thirty nine percent stated they had no warning mechanisms in place, although this may be a result of the organisations not being required to warn the community.

The media was essential in communicating warning and hazard information to the community (Table 28). Radio stations were the key media relied upon. Many of the responding organisations relied on a functioning telecommunication network for their warning mechanisms, emphasising the importance of continued functioning for this network during an emergency.

Of the organisations that used warning mechanisms (15), 60% believed their mechanisms were very effective at achieving their purpose (Table 28). One third believed their mechanisms to be somewhat effective. Only one respondent believed they were not very effective. This was due to several people being set up to respond to queries from staff and compounded by managers being unable to get into the head office.

Sixty percent of the respondents that used mechanisms to warn the community (15) believed they were very effective (Table 29). Only one respondent believed that they were not very effective.

There was some desire for more readiness info from MCDEM and MAF, espeically for farmers (i.e. do's and don'ts).

6.4.5 Impact assessment

The June 2006 snowstorm event highlighted the difficulties for emergency responders in assessing impacts and providing adequate response. Most agencies had their response/emergency plan activated within 1 day (often by 9am) of receiving warning and initial impact assessments. However, most responding organisations reported it took approximately three days to assess the scale and magnitude of the event, and to get the response fully mobilised.

Some infrastructure providers indicated they used a reactive approach, waiting for faults to occur on their network and/or for people to make contact with them.

Rural respondents generally felt they were successful in impact assessment, especially for spotting and saving trapped livestock.

In several instances helicopters were used for impact assessment and transporting emergency responders. Rural respondents believed their use was highly successful and valuable in locating trapped livestock and assessing damage to farms. They noted they were also able to collect additional information for other responders. Infrastructure providers acknowledged there was value in using helicopters initially for impact assessment, but most inspection and repair work needed to be carried out by crews on the ground.

Many agencies, particularly infrastructure providers, indicated a desire for improved impact assessment, specifically during and immediately-after the event. Some agencies felt that this related to poor information dissemination, usually as a result of poor communications. This included the damaged telecommunications network and poor information sharing between responders. Some respondents, usually non-infrastructure service providers, believed that there wasn't a clear, systematic approach to on-going assessment of impacts and how well people were coping. This was also reported by some farmers (Smith, 2007).

The ability to quickly and rapidly assess where the damage was most intense during the snowstorm event appears to have been a function of local knowledge (of areas likely to be badly impacted), reconnaissance by key operational personnel, and from information collected from impacted communities - usually from telephoning in (which highlighted the need for reliable telecommunications).

Some organisations noted it was important to rapidly and effectively assess impacts and then continue to monitor effects for as long as required. Some households may be self reliant for the first couple of days, but after that point they begin to struggle. Monitoring therefore must continue after the initial reconnaissance.

6.5 Rural impacts

Impacts on the rural community were severe and generally much greater than on the urban sector. Immediate animal welfare and environmental impacts were relatively low given the event occurred following favourable climatic conditions leaving farmers with livestock in good condition and good reserves of supplementary feed. There was significant concern that a

subsequent snowfall during the following winter months would require a larger response, given the increased vulnerability of farm and the electricity network following the June event. Smith (2007) recorded that many farming families suffered significant social and economic hardship during and following the snowstorm.

One of the key issues for communities impacted by the storm was that many rural families were not concerned about problems on the first or second day of the event, however by the forth or fifth day when there were still severe problems they began to struggle. At this point there didn't look like there would be a rapid recovery (Smith, 2007). This emphasised the importance of functioning telecommunications for emergency communciations and local support networks to provide support.

Many of the responding organisations dealt closely with impacted rural communities. A huge response effort was mounted by rural support organisations, with many thousand livestock rescued and fed. Many farmers received Taskforce Green teams to assist in repairing damage.

6.6 Lessons learned

This snowstorm event highlighted infrastructure vulnerability and the high dependency society has on key services. This has strong implications for other potential natural hazards. Whilst this snowstorm event has been acknowledged as a small to medium sized disaster, it left many people without essential services for weeks at considerable social cost. It is questionable whether there is the required capacity available within New Zealand to effectively respond to a larger natural disaster. Such an event reinforces the need to adequately plan and prepare for natural disasters.

Key lessons taken from responses to this survey include:

- There is a strong desire for a more detailed and accurate meteorological warning of what impacts snowstorms will cause spatially and temporally, and the characteristics of the snow itself. The analysis of response plan highlights the importance of accurate and timely hazard warnings or impact assessments for response plan activation.

- The value of effective and efficient impact assessment was highlighted during and following this event. It is important information on impacted communities and damaged infrastructure networks is gathered as soon as possible. Aside from obvious benefits of being able to repair damage and quickly respond to problems, this also has important implications for relieving a concerned community and informing central government so aid can be approved.
- Widespread electrical power failure is largely inevitable in a large South Island snowstorm. Organisations and communities need to adequately prepare for this reality.

- The failure of communications systems for many organisations (and households) during the snow caused significant problems. Organisations should diversify their communications systems to mitigate this problem, i.e. adopt radiotelephones or satellite phones.

- Disrupted transport networks made it important for emergency responders (i.e. repair crews) to be equipped with vehicles capable of dealing with these severe conditions (i.e. 4WD and chains).

- Experienced staff, staff training and continuously updated emergency response plans proved they were highly effective in increasing an organisation's performance.

- Coordination of information and communications at intra-organisational and inter-organisational levels appeared to be lacking in some areas during the response to the snowstorm event. Future planning should focus on more effective co-ordination of dissemination of hazard, impact and resource availability information during the response phase.

- The snowstorm highlights the value of inter-organisational planning, i.e. intimately understanding how other organisations operate, their abilities and attributes, and the appropriate people to contact.

- Rural communities will generally be without essential services for much greater periods than urban areas and may suffer isolation for extended periods. They should plan to adequately deal with this reality.

7.0 ACKNOWLEDGEMENTS

The authors would like to acknowledge the Canterbury Civil Defence and Emergency Management Group for financial support with this study. Thanks to Jon Mitchell and John Fisher for their time and contributions. We would also like to acknowledge Terry Donald, AgriQuality, and John Greer, MAF Policy, for their time and valuable comments. Thanks to Nicola Schuyt and Julia Becker for insight comments and review.

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APPENDIX 1 2006 SNOW STORM QUESTIONNAIRE

1. In what area is your agency based? _____

2. During the time you have worked in your present position how many times have you been involved with managing a natural hazard event? (e.g., snow storm, floods, earthquakes). Please only tick one.

Never _____
Once _____
Two - four times _____
More than four _____

3. With respect to dealing with such natural hazards, how would you describe the level of experience a) you and b) your agency have of disaster management? Please only tick one for each section.

Yourself		Your Agency	
Considerable	_____	Considerable	_____
Moderate amount	_____	Moderate amount	_____
Very little	_____	Very little	_____

4. Did your agency have a response plan for dealing with a snow storm-related disaster?

Yes _____ (please go to question 5)
No _____ (please go to question 8)

5. If a plan was in place was it based on:

	yes	no
a. Specific Snow storm plans	_____	_____
or		
b. Adapting other plans	_____	_____

6. Did the plan cater for: (tick one per line and all that apply)

	yes	no
Technical/infrastructure problems	_____	_____
Staff competencies/well-being	_____	_____
Community issues	_____	_____
Economic issues	_____	_____
Political issues	_____	_____
Social issues	_____	_____

7. Did your plan include inter-agency management planning?

yes no

If yes, please list the other agencies included in your plan.

_____
_____
_____
_____
_____
_____
_____
_____

8. Did any unexpected inter-agency issues emerge as a result of the response

yes no

If yes, please list these agencies and any issues identified

_____
_____
_____
_____
_____
_____
_____
_____

9. Were you given warning about the potential impacts of this snow storm event? (please tick one only)

Not given any warning	_____	(please go to question 19)
One day	_____	(please go to question 9)
More than one day	_____	(please go to question 9)

10. From whom did you receive this information? (tick all that apply)

From within my organisation _____
Meteorological Service _____
Ministry of Civil Defence & Emergency Management _____
District Council _____
Regional Council _____
Local Civil Defence _____
Meteorological Service _____
Television _____
Radio _____
Newspaper _____
Friends/relatives _____
Other (please specify)
_____ _____
_____ _____
_____ _____
_____ _____

11. Did this information reach you in your official capacity?

Official _____
Other _____

(Please specify)

_____
_____
_____

12. What action(s) resulted from the receipt of this information?

_____
_____
_____
_____
_____

13. What was your first reaction?

_____
_____
_____
_____
_____
_____

14. At that point, how serious a threat to the community did you think such a snow storm event might be? (Please only tick one)

Very serious _____
Somewhat serious _____
Not serious _____
Not sure _____

15. On being informed, did you contact other people or agencies?

Yes _____
No _____ (please go to question 19)

If yes

Whom?

_____
_____

When?

_____
_____

What did you tell them?

_____
_____
_____
_____
_____
_____

16. Did you have problems making a decision based on the information that you had available to you?

Yes _____
No _____

If yes, please describe.

_____
_____
_____
_____
_____
_____

17. Did you receive (Please only tick one)

Too much information _____
The right amount of information _____
Too little information _____

18. If you sought information, was it

Readily available _____
Difficult to obtain _____

19. Was the information you required obtainable from

One source _____
Several sources _____

Please describe the source(s) of the information you deemed necessary for your role

_____
_____
_____

20. What type of information/data would you like to see in hazard warning that would have helped you in your decision making?

Please describe/list

_____
_____
_____
_____
_____
_____

21. At what point was the response plan implemented? (Please only tick one)

No response plan _____ (please go to question 24)
On receiving warning _____
On receiving impact assessment _____

22. How long did it take for the plan to become operational?

_____ days

23. Was this (Please only tick one.)

Longer than expected _____
As expected _____
Quicker than expected _____

24. What constraints to plan implementation did you encounter? (Please tick all that apply)

No constraints _____
Time for mobilisation _____
Time to obtain resources _____
Resources not available _____
Not wanting to raise unnecessary alarm _____
Inadequate communication _____
With community members _____
With other agencies _____
Inadequate coordination _____
Other (please specify)
_____ _____
_____ _____

25. Looking back on the snow storm, what sources of information do you feel should be developed to promote better preparedness should such an eventuality occur in the future?

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

26. What mechanisms did you have in place to warn the community?

No mechanisms _____ (please go to question 29)
Mechanisms in place _____

27. If your agency had mechanisms in place, please describe them

_____
_____
_____
_____
_____
_____
_____

28. If these mechanisms were used, how effective were they in achieving their purpose? (Please only tick one)

Very effective	_____	(please go to question 29)
Somewhat effective	_____	(please go to question 29)
Not very effective	_____	(please go to question 28)
Not sure	_____	(please go to question 28)

29. If you ticked 'not very effective' or 'not sure', please describe why

_____
_____
_____
_____
_____
_____
_____
_____
_____

30. Did your agency take action to deal with the effects of the snowstorm?

Yes	_____	
No	_____	(please go to question 31)

If yes, please describe the actions taken

_____
_____
_____
_____
_____
_____
_____
_____
_____

31. Do you think that your actions led to any positive outcomes?

Yes _____
No _____ (please go to question 31)

If yes, please describe

_____
_____
_____
_____
_____
_____
_____
_____

32. What were the major effects, if any, of the snow storm in the area covered by your agency?

_____
_____
_____
_____
_____
_____

33. Did you experience any problems in performing your role?

Yes _____
No _____

If yes, please describe

_____
_____
_____
_____
_____
_____
_____
_____

If no, was this because

The response plan was effective _____
No response was necessary _____
Other _____

Please describe

_____
_____
_____
_____
_____
_____
_____

34. Please read through the following list of possible problems that could have adversely influenced your organisations effectiveness in responding to the snow storm event. I would like you to list whether you experienced any of these problems and, if so, to estimate how serious a threat each was to response effectiveness

	Posed a problem		**If yes *(please circle one per line)***		
	Y	N	Unimportant	Important	Very Important
Lack of appropriately trained personnel	Y	N	1	2	3
Lack of equipment	Y	N	1	2	3
Lack of facilities (e.g., accommodation)	Y	N	1	2	3
Inadequate communication					
With other agencies	Y	N	1	2	3
With the community	Y	N	1	2	3
Inadequate coordination of of response	Y	N	1	2	3
Lack of clear responsibility for coordination	Y	N	1	2	3
Media problems	Y	N	1	2	3
Management issues	Y	N	1	2	3
Public cooperation	Y	N	1	2	3

Please provide additional information on issue(s) relating to response effectiveness

_____
_____
_____
_____
_____
_____
_____
_____
_____

35. If your response plan was implemented, how effective was it? (Please only tick one)

Very effective _____
Somewhat effective _____
Not very effective _____
Not sure _____

36. Did you learn anything from your experience in dealing with this snow storm?

Yes _____
No _____ (please go to question 36)

If yes, please describe

_____
_____
_____
_____
_____
_____
_____
_____

37. Were there any other positive or negative effects resulting from this experience?

Positive	Negative
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

38. Were the effects of the snow storm (Please only tick one)

Much greater than expected _____
Greater than expected _____
As expected _____ (please go to question 39)
Less than expected _____
Much less than expected _____

39. If the effects differed from your expectations, please describe the nature of the differences

_____
_____
_____
_____
_____
_____
_____

40. If the effects of the snow storm were as expected, on what information or experience was this expectation based? Please describe

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

41. What was the total cost (estimated or otherwise) to your organisation in terms of the response to the snow storm? (please add any costs as appropriate in space provided)

Management/coordination	_____
Clean up/Snow clearing	_____
Social Support	_____
_____	_____
_____	_____
_____	_____

Restoring damaged infrastructure

- buildings	_____
- electricity lines	_____
- emergency generators	_____
- roading	_____
- water supplies	_____
- waste water/sewerage	_____
- telecommunications	_____
- _____	_____
- _____	_____
- _____	_____

42. Do you expect that there will be any long term effects arising from this snow storm? (Please tick one per line)

	yes	no
No long term effects	_____	_____
Political	_____	_____
Economic	_____	_____
Social	_____	_____
Community	_____	_____
Other (please describe)		
_____	_____	_____
_____	_____	_____
_____	_____	_____

43. If you answered yes to any of the above, please describe the long term effects that you might anticipate

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

44. On the basis of the 2006 snow storm, how well prepared is your agency to deal with any future snowstorm event? (Please only tick one)

Very well prepared	_____
Well prepared	_____
Not well prepared	_____

45. On what do you base this assessment? Please describe.

_____
_____
_____
_____
_____
_____
_____
_____

46. How likely do you think it is that a snow storm of this magnitude will occur in the future? (Please only tick one)

Very likely _____
Somewhat likely _____
Not likely _____
Not sure _____

47. Could you please comment or list any changes you will make to increase resilience to snow storms in the future to your:

Organisation

_____
_____
_____
_____
_____
_____
_____
_____

Managed infrastructure

_____
_____
_____
_____
_____
_____
_____
_____

Other aspects of your business

_____
_____
_____
_____
_____
_____
_____
_____

Thank you for your time and cooperation in completing this survey. Should you wish to receive a copy of the findings of this survey, please provide a name and contact address below or send details to Tom Wilson (address below).

Should you require any additional information on this survey, any of its content, or disaster management in general, please do not hesitate to contact Tom Wilson (Natural Hazard Research Centre, University of Canterbury, Private Bag 4800, Christchurch. Tel: 03 364 2700, Email: tmw42@student.canterbury.ac.nz).

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